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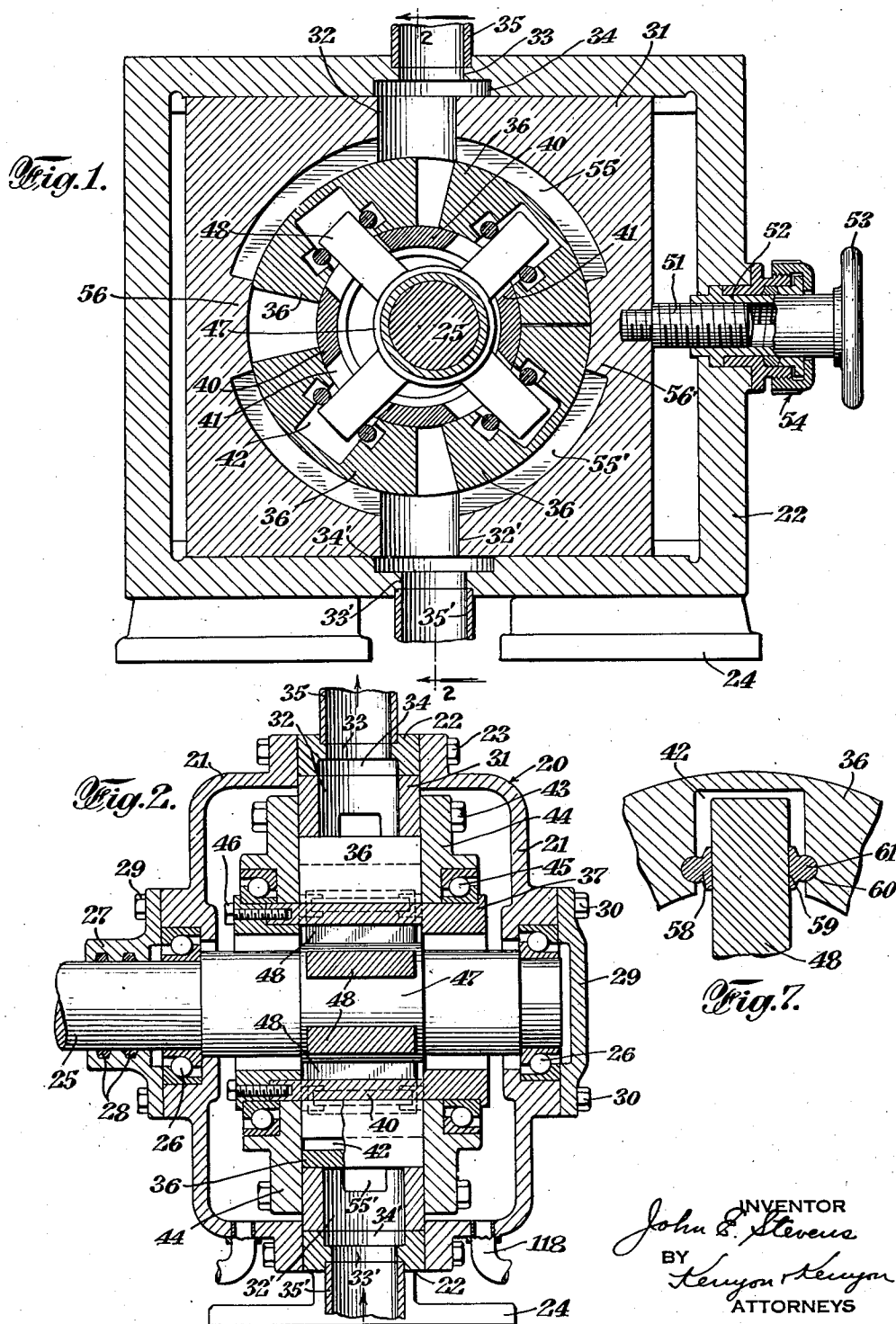
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2,096,074

ROTARY COMPRESSOR MOTOR APPARATUS

Filed June 29, 1935

5 Sheets-Sheet 1



Oct. 19, 1937.

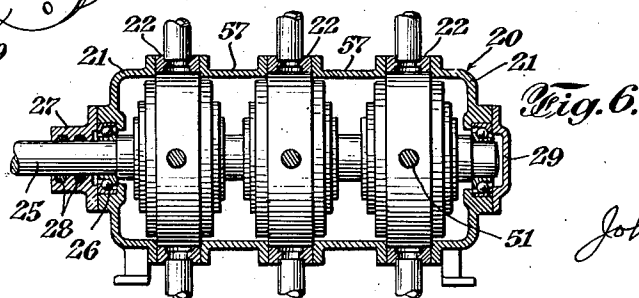
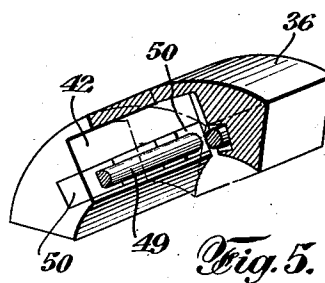
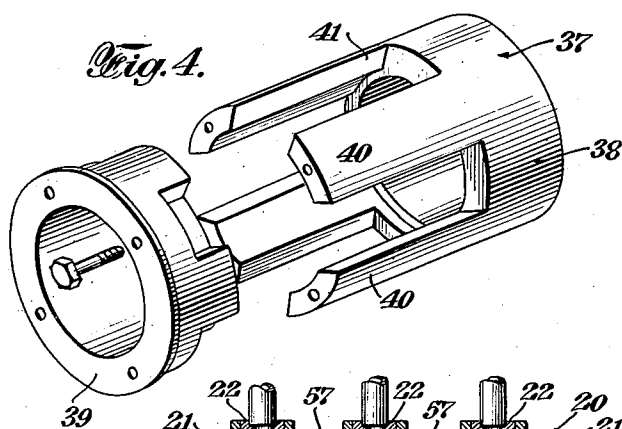
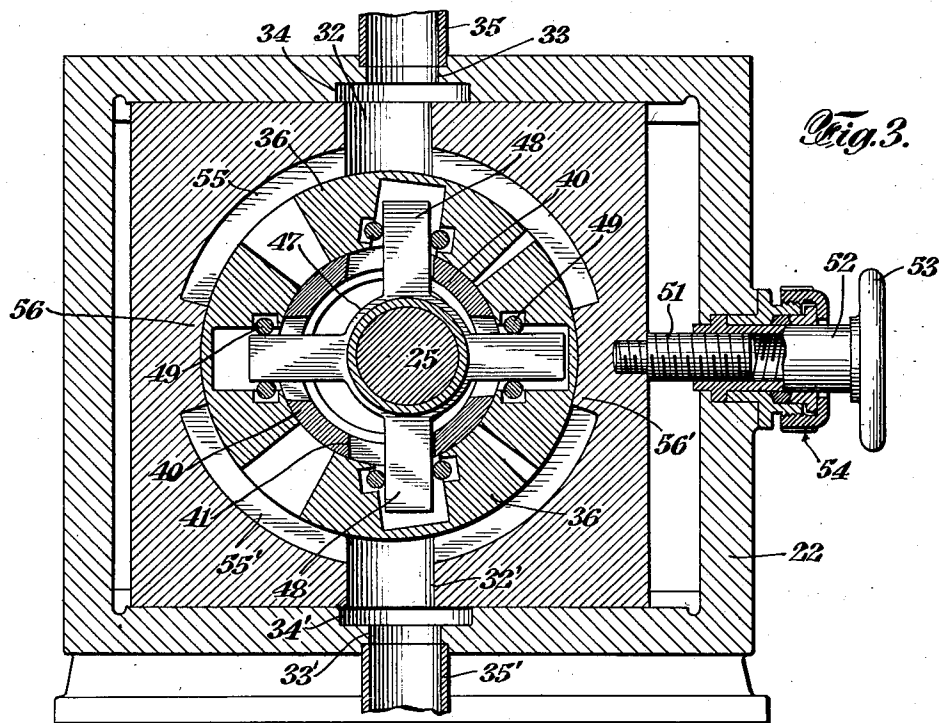
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ROTARY COMPRESSOR MOTOR APPARATUS

Filed June 29, 1935

5 Sheets-Sheet 2



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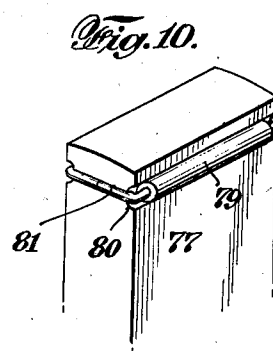
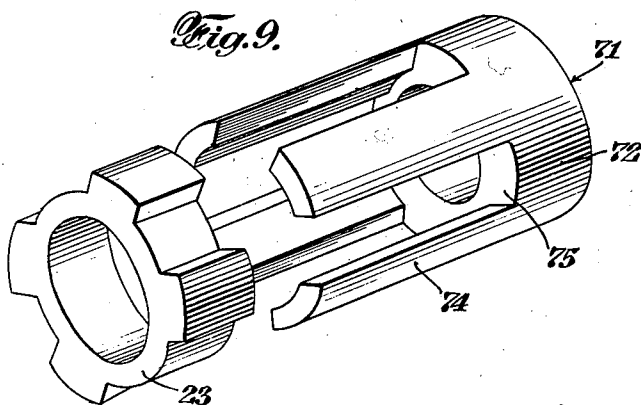
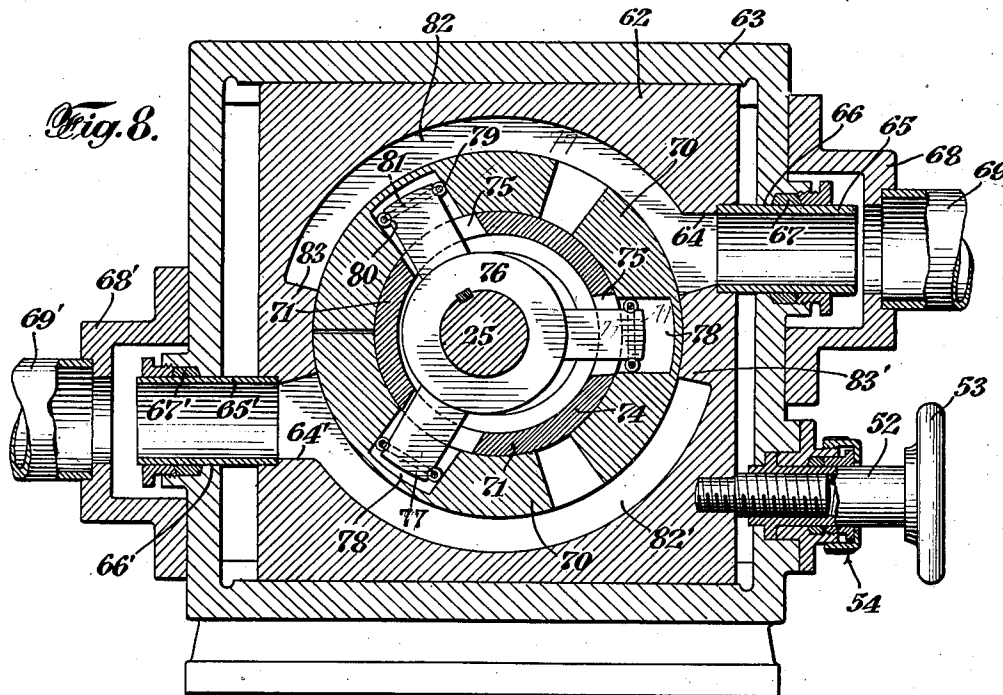
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ROTARY COMPRESSOR MOTOR APPARATUS

Filed June 29, 1935

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ROTARY COMPRESSOR MOTOR APPARATUS

Filed June 29, 1935

5 Sheets-Sheet 4

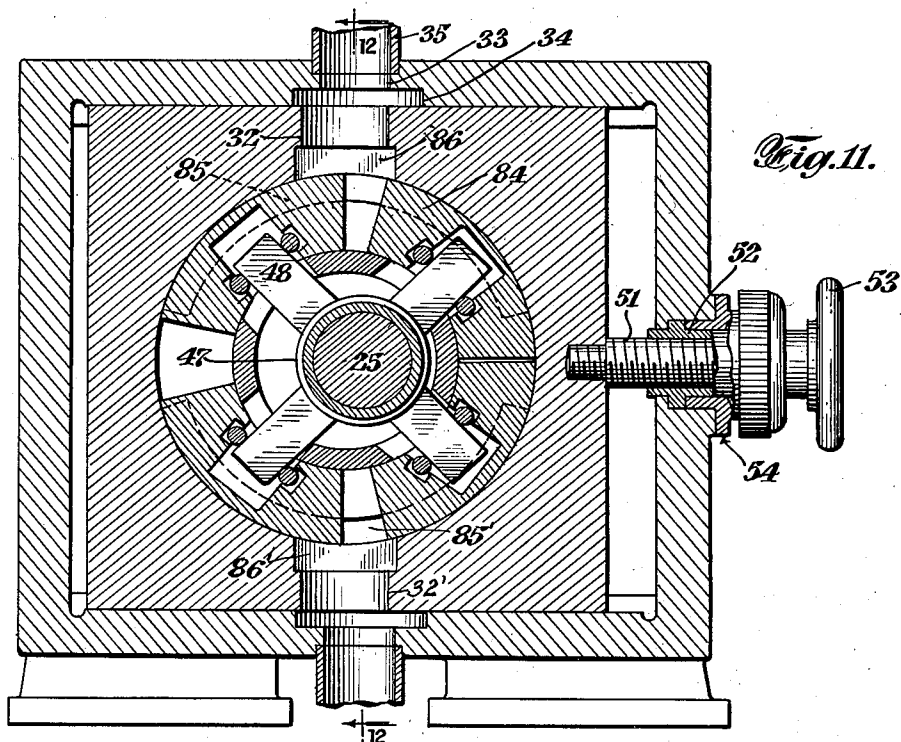


Fig. 11.

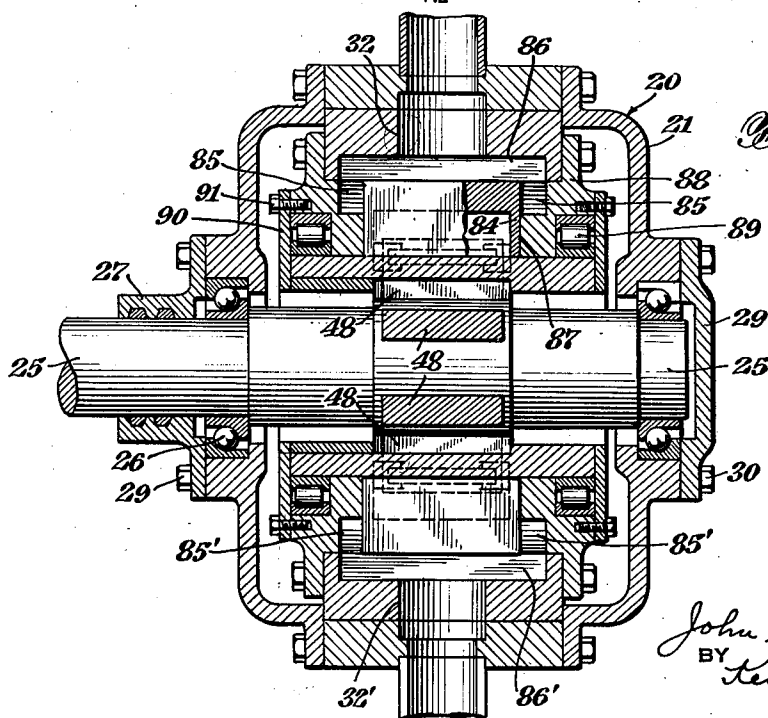


Fig. 12.

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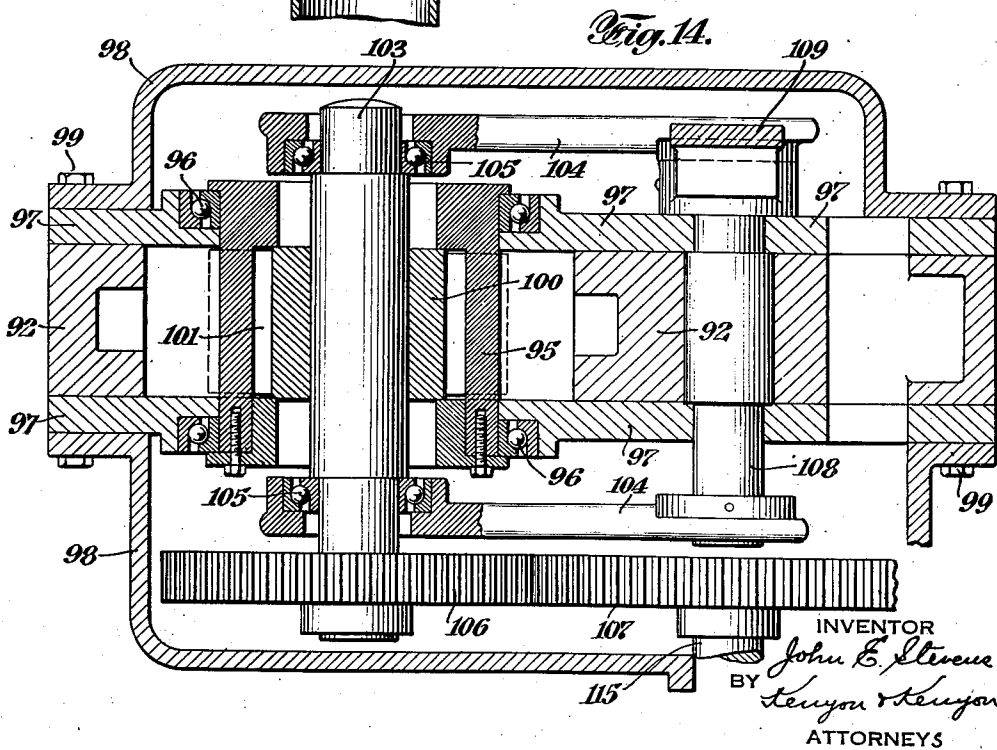
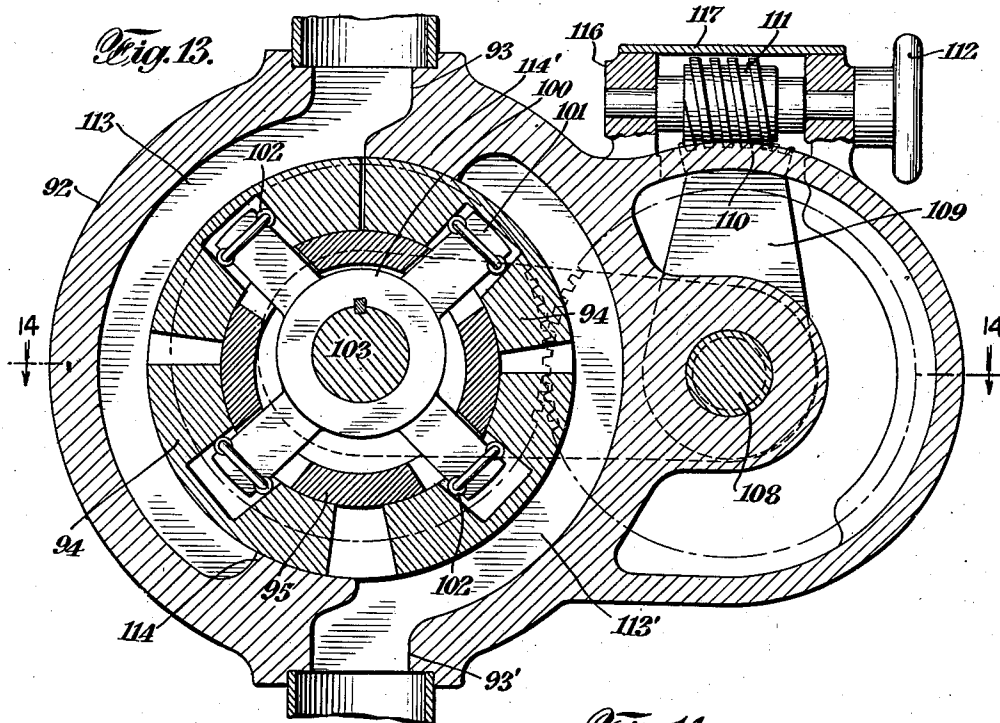
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ROTARY COMPRESSOR MOTOR APPARATUS

Filed June 29, 1935

5 Sheets-Sheet 5



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2,096,074

ROTARY COMPRESSOR-MOTOR APPARATUS

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Application June 29, 1935, Serial No. 28,995

11 Claims. (Cl. 103-129)

This invention relates to rotary compressor-motor apparatus. By "compressor-motor apparatus", it is to be understood that the apparatus is such that, when driven by mechanical means, it can operate as a fluid compressor and that, on the other hand, when fluid is introduced into the apparatus under pressure, the apparatus can serve as a motor. It is to be further understood, however, that features of this invention relate both to apparatus adapted to be used only as a compressor and to apparatus adapted to be used only as a motor.

The apparatus of this invention is primarily intended for use as a pump. While it can be built as a general service pump, it is especially suitable for application to machine tool drives, hydraulic press operation, marine steering gear, and for similar services where high speeds and pressures and/or variable displacement with a constant speed drive are particularly desirable.

It is a purpose of this invention to make apparatus of the character described which is of high efficiency and which at the same time is of extremely strong and simple construction. It is an advantage of the structure of this invention that the parts thereof may be readily machined with precision so that parts having the desired closeness of fit can be readily manufactured. It is a further purpose and advantage of this invention that the apparatus embodying the invention contains parts which are in balance and in operation produce an extremely slight amount of noise and vibration. It is a further purpose of this invention to afford compressor-motor apparatus which is adapted to be operated at high speeds and under high pressures.

Features of this invention relate to improved interconnecting means between a plurality of sector pistons and a rotatable shaft. Thus, according to preferred embodiments of this invention, the sector pistons are driven by a yoke fixed to a rotating shaft without the interposition of complicated apparatus between the shaft and the sector pistons.

Further features of this invention relate to the use of a sleeve which is rotatably mounted with respect both to the sector pistons and with respect to the cylinder block in which the sector pistons are adapted to rotate. Additional features relate to the construction below described, whereby fingers forming part of a yoke attached to the drive shaft pass outwardly through openings in the sleeve and into interiorly opening recesses in the sector pistons.

Further features of this invention relate to the

passage means affording communication between spaces between the sector pistons and the inlet and outlet ports of the cylinder block and between these ports and openings in the surrounding casing. In one embodiment of this invention, such passage means is so situated as to substantially reduce the fluid pressure on the rotating parts of the apparatus.

Further features of this invention relate to means for moving the drive shaft with reference to the cylinder block so as to adjust the degree of eccentricity between the axis of the cylinder block and the axis of the drive shaft. In certain embodiments of this invention, the cylinder block is fixed and the drive shaft is moved with reference thereto, and in other embodiments of this invention, the drive shaft is fixed in relation to an outer casing and the cylinder block is moved with reference to the drive shaft.

Further features of this invention relate to the construction of the sector pistons and to the assembly of the parts of the apparatus. It is a further feature of this invention that several units of compressor-motor apparatus may be mounted on a single shaft. For example, a battery comprising a plurality of pumps may be mounted on a single shaft and by the adjustment feature of this invention, some units may be adjusted so as to be pumped to full capacity, other units may be adjusted so as to be idling without producing any pumping effect, and still further units may be adjusted so as to be pumping in reverse, for example, at the same time.

It is an advantage of apparatus embodying this invention that, on the liquid side thereof, the movements of the parts are purely rotary and that there are no sliding vanes or reciprocating pistons. It is also an advantage of apparatus embodying this invention that all contact surfaces are large, and that there are no line or edge closures.

Further purposes, features and advantages of this invention will be apparent in connection with the following description of certain illustrative embodiments of this invention which are shown in the accompanying drawings, wherein:

Figure 1 is a side sectional view of one form of apparatus embodying this invention;

Figure 2 is an end view largely in section of the apparatus shown in Fig. 1 taken on the line 2-2;

Figure 3 is a side sectional view similar to Fig. 1, with the parts in a different relative position with respect to each other;

Figure 4 is a perspective view of the sleeve which forms a part of the apparatus shown in

Figs. 1, 2 and 3 with the elements of the sleeve separated;

Figure 5 is a perspective view of one of the sector pistons which are employed in the apparatus shown in Figs. 1, 2 and 3;

Figure 6 is a front view, partly in section, illustrating how a battery of units may be mounted on a common shaft;

Figure 7 is a side sectional view of a modified form of bearing construction interposed between the fingers of the yoke member and the sector pistons;

Figure 8 is a side sectional view of a modified form of apparatus embodying this invention;

Figure 9 is a perspective view of a modified form of sleeve which may be used in apparatus embodying this invention;

Figure 10 is a perspective view of one of the fingers of the driving yoke and shows a modified form of bearing in association therewith;

Figure 11 is a side sectional view of a further modification of apparatus embodying this invention;

Figure 12 is an end view largely in section along the line 12—12 of the apparatus shown in Fig. 11;

Figure 13 is a side sectional view of a further modification of apparatus embodying this invention, and

Figure 14 is a plan view, largely in section, along the line 14—14 of Fig. 13.

Referring to the foregoing drawings, the apparatus shown in Figs. 1, 2 and 3 comprises an outer casing which is indicated generally by the reference character 20 and which may comprise a pair of castings 21, spaced apart by spacing member 22, these parts being held in assembled relation by bolts 23. The apparatus as a whole may be mounted on a suitable foundation plate 24 which may, for example, be secured to or integral with the spacing member 22. The shaft 25 is mounted for rotation with respect to the casing 20 by suitable bearings 26. If the drive shaft extends out of the casing 20, an end member 27 is provided having, for example, packing rings 28 to make a substantially fluid-tight seal between the driveshaft and the end member 27. The end member 27 may be attached to the castings 21 by any suitable means such as bolts 29. If a unit as a whole is mounted on a continuous shaft, both sides of the apparatus may be provided with end members similar to end member 27. If, however, the shaft does not pass entirely through the apparatus, and is constructed as shown in Fig. 2, the side of the apparatus opposite to that carrying end member 27 may be provided with a plate 29 attached to castings 21 as by bolts 30.

Within the casing 20 is the cylinder block 31. The cylinder block 31 in the embodiment shown in Figs. 1, 2 and 3 is slidable along the top and bottom thereof with reference to the inner surfaces of the top and bottom portions of spacer 22. The cylinder block 31 is provided with ports 32 and 32'. Either one of these ports may serve as an inlet port or an outlet port, depending upon the direction of rotation of the parts hereinafter described or upon the relative position of such parts. The ports 32 and 32' are in communication with openings 33 and 33' in the spacer member 22 forming part of casing 20. The openings 33 and 33' have flared portions 34 and 34' so that ports 32 and 32' will remain in communication with openings 33 and 33' notwithstanding change of position of cylinder block 31 with reference to spacer member 22, for purposes de-

scribed more in detail below. Leading to openings 33 and 33' are pipes or other suitable passages 35, 35'.

Rotatably mounted within the cylinder block 31 are a plurality of sector pistons 36. In the embodiment here described, four of these sector pistons are shown. The sector pistons 36 are maintained in position by a sleeve which is indicated generally by the reference character 37 and comprises a member 38 adapted to interlock with a complementary member 39. The sleeve 37 has portions 40 which are adapted to underlie the spaces between the sector pistons 36 and afford a substantially fluid-tight closure for the bottom of these spaces. Between the portions 40 are openings 41 which are adapted to be in registration with interiorly opening recesses 42 in sector pistons 36. In Figs. 1, 2 and 3, the recesses 42 are merely in the form of slots cut through the sector pistons at approximately the mid-portion thereof.

The sleeve 37 is rotatably mounted with respect to the cylinder block and likewise with respect to the sector pistons. Secured to each side of the cylinder block 31 as by bolts 43 are side plates or side walls 44 and between side plates 44 and the sleeve 37 are bearings 45. The side plates 44 fit alongside the sides of sector pistons 36 so as to afford a slidable but substantially fluid-tight contact between the surfaces of these members. The members 38 and 39 of sleeve 37 may be maintained in assembled relation by any suitable means such as the bolts 46. Fixed to the shaft 25 is a yoke member 47 having fingers 48 which pass through the openings 41 in sleeve 37 and extend into the recesses 42 of sector pistons 36. The fingers 48 are telescopically slidable into and out of the recesses 42 and are also freely movable through the openings 41 of sleeve 37. In order that the sliding friction between the sector pistons and the fingers 48 may be reduced to a minimum, suitable bearings may be interposed between the fingers of the yoke and the sector pistons. One type of bearing for this purpose is shown in Fig. 5, where roller bearings 49 are shown set in suitable blocks of bearing metal 50 in the side wall of recess 42 of sector pistons 36.

Suitable means are provided for adjusting the eccentricity of the axis of the drive shaft with reference to the axis of the cylinder block. In Figs. 1, 2 and 3, a threaded member 51 is secured to one side of the cylinder block 31 and is adapted to cooperate with internally threaded sleeve 52 attached to hand wheel 53 which is outside of casing 20. Suitable packing and gland arrangements indicated generally with reference character 54 may be employed to prevent leakage of liquid from within the casing. By rotating the hand wheel, the cylinder block 31 can be moved transversely with respect to the shaft 25. As above described, this movement can be made while maintaining the ports 32 and 32' in communication with openings 33 and 33' of the casing. The sliding contact between the cylinder block and the spacer member 22 affords a substantially fluid-tight joint between these members, while permitting slidable movement between these members.

Communicating with ports 32 and 32' are annular passages 55 and 55' which serve to afford communication between spaces between the sector pistons and the ports 32 and 32'. The annular passages are terminated by barriers 56 and 56' which serve to divide any fluid in the appa-

ratus into two portions. One portion of the fluid includes fluid in certain spaces between the sector pistons and in passage means communicating with port 32 which may, for example, be an outlet port. The other portion of fluid includes that confined in other spaces between the sector pistons and those passage means communicating with port 32' which may, for example, be an inlet port. Thus passage means independent of each other are afforded which lead to inlet and outlet ports respectively in the cylinder block.

The operation of the device shown in Figs. 1, 2 and 3 is believed to be apparent. When the axis of the shaft 25 is in eccentric relation to the axis of cylinder block 31 as shown in Figs. 1, 2 and 3, space between any two of the sector pistons successively becomes greater and smaller, upon rotation of the shaft. This mechanical motion is also referred to herein as one wherein the sector pistons successively move at varying speeds. During this motion of the sector pistons, the fingers of the yoke move in and out of the recesses in the sector pistons and the sleeve is rotated at a substantially constant speed. Assuming that the shaft 25 is being driven in a clockwise direction, it is believed to be apparent that the sector pistons in the lower half of their revolution will become increasingly spaced from each other. In the upper half of their revolution, they progressively become closer to each other. In Fig. 1, the sector pistons are shown at the right-hand side of the drawing as substantially adjacent to each other at a point overlying stop 56'. On the opposite side of the apparatus and opposite stop 56, the sector pistons are separated by a maximum space from each other. In Fig. 3, the parts of the apparatus are shown in a different relative position with respect to each other, the central portions of the sector pistons being opposite stops 56 and 56' and the spaces between the sector pistons being in only partially opened position. If pipe 35' is connected to the supply of suitable fluid such as oil, water or the like, it is apparent that the liquid will be drawn into the apparatus due to the fact that the spaces between the sector pistons in communication with this pipe line are continuously increasing in width. The oil thus introduced into spaces between the sector pistons will be discharged through the outlet pipe 35 since the spaces between the sector pistons in communication with the outlet pipe 35 are continuously becoming smaller. Thus, a continuous and non-pulsating flow of fluid such as the liquids oil or water is achieved.

The apparatus has its maximum capacity when the degree of eccentricity between the axis of the drive shaft and the axis of the cylinder block is at a maximum. When the cylinder block is moved with respect to the axis of the drive shaft so that the axes of these members become concentric, then the apparatus is in idling position and no pumping effect is secured. If the axis of the cylinder block is moved from one side of the axis of the shaft to the other side of the axis of the shaft, the direction of flow of fluid through the apparatus will be reversed. Reversal of fluid through the apparatus can also, of course, be accomplished by continuing to maintain the axis of the cylinder block on the same side of the axis of the drive shaft and reversing the direction of rotation of the drive shaft.

While the apparatus may operate as a compressor, it also may be used as a motor. Thus

by forcing fluid into the inlet pipe 35', for example, the effect of the compressed fluid will be to tend to separate the sector pistons in contact with the compressed fluid, and if there is substantial pressure differential in lines 35' and 35 with the lower pressure in line 35, the shaft 25 will be caused to rotate in a clockwise direction.

The apparatus above described can also be used as a variable speed hydraulic transmission as by using one device with a fixed center as a motor and another device with variable displacement means to provide the operating pressure fluid.

In Fig. 6, a plurality of units are shown mounted on a single shaft. The construction may be substantially the same as the construction shown in Figs. 1, 2 and 3, except that castings 21 are used in conjunction with separator castings 57. The spacer members, such as the spacer members 22 may be maintained between the castings 21 and 57 and/or between successive castings 57 as shown. The moving of the position of the cylinder blocks 31 in each of the units may be accomplished by adjusting means, including members 51 and associated parts of the type described above. Where a battery of three units, for example, is used, as shown in Fig. 6, it is apparent that one of the units may, for example, be employed at maximum capacity, another of the units may be idling and the third of the units may be operating in reverse. Also any modification of the capacity of each of the units or of the direction of flow therethrough may be had in connection with a shaft adapted to be rotated at constant speed.

In Fig. 7, a modified form of anti-friction device between finger 48 and the side wall of recesses 42 of sector pistons 36 is shown. The bearings in this case consist of members 58 having surfaces 59 adapted for sliding contact with the surface of fingers 48 and rounded portion 61 adapted to rock in groove 60 in sector pistons 36.

In Figs. 8, 9 and 10, an alternative embodiment of this invention is shown. In this modification, a cylinder block 62 is mounted slidably within spacer member 63 which may comprise part of a suitable casing of the type shown in Figs. 1, 2 and 3. The cylinder block has ports 64 and 64' to which are secured tubular members 65 and 65'. The latter members are slidable through openings 66 and 66' in spacer member 63 and a substantially fluid-tight joint is afforded by packing glands 67 and 67'. Secured to the spacer member 63 are housings 68 and 68' adapted to receive the tubular members 65 and 65' when they are projected into these housings in moving the cylinder block 62 with reference to the spacer member 63. Pipes 69 and 69' are secured to the housings 68 and 68' and may serve either as inlet or outlet pipes, depending upon the operation of the apparatus. The cylinder block is moved with reference to the spacer member 63 by means of a hand wheel 53 and associated members which are shown as of the same character as in the embodiment above described in connection with Figs. 1 and 3.

Within cylinder block 62 are mounted for rotation sector pistons 70. In the embodiment shown in Fig. 8, three of these sector pistons are shown. The sector pistons are maintained in position by means of a sleeve indicated generally by the reference character 71 comprising members 72 and 73 and are adapted to interlock into assembled relation with each other. The sleeve 71 includes portions 74 with openings 75 therebetween.

Associated with the drive shaft 25 is a yoke 76 which may be keyed to the drive shaft and the yoke 76 comprises fingers 77. The fingers 77 pass through openings 75 of the sleeve 71 and into interiorly opening recesses 78 of the sector pistons 70. In the embodiment shown in Figs. 8 and 10, the bearings between the fingers 77 and the sector pistons 70 are mounted on the fingers 77 and may comprise rollers 79 held in position in grooves 80 by clip members 81.

Communicating with port 64 is an annular passage 82 which is terminated by stop portion 83. Communicating with port 64' is another annular passage 82' which is terminated by stop 83' and is independent of passage 82.

The operation of the device shown in Figs. 8, 9 and 10 is substantially identical with the operation of the device shown in Figs. 1, 2 and 3 and description of this operation will not be repeated.

A still further modification of the apparatus shown in this invention is shown in Figs. 11 and 12. In this modification, the structure of the casing 20, the means for moving the cylinder block relative to the casing, the drive shaft, and the means for affording communication between openings in the casing and ports in the cylinder block, are substantially identical with the corresponding means and structural elements shown in Figs. 1, 2 and 3, described above and have been indicated in Figs. 11 and 12 by the same reference characters as those referred to in Figs. 1, 2 and 3. Likewise, the structure of the yoke 47 and fingers 48 is the same as in the structure shown in Figs. 1, 2 and 3 and are indicated by the same reference characters.

In Figs. 11 and 12, the passages which afford communication between the spaces between the sector elements and ports 32 and 32' of the cylinder block are disposed at the side of the sector pistons 84. A pair of annular passages 85, one on each side of sector pistons 84, communicate with port 32 and a pair of passages 85' communicate with port 32'. While a pair of such annular passages are preferred, one passage on one side of the sector pistons may also be employed.

The ports 32 and 32' are provided with local enlargements 86 and 86' so that fluid may flow from passages 85 to port 32 and from passages 85' to ports 32'. When side passages are employed as shown in Figs. 11 and 12, the sector pistons include side walls 87 which abut against side wall members 88 to afford a substantially fluid-tight joint. The sleeve member may be either of the form shown in Fig. 4 or the form shown in Fig. 9. In the modification shown in Fig. 12, however, a somewhat different form of roller bearing 89 is shown and the bearings and sleeve members are held in assembled relation by plates 90 which may be secured to members 88 as by bolts 91. The operation of the device shown in Figs. 11 and 12 is substantially the same as the operation of the device shown in Figs. 1, 2 and 3. However, the embodiment of passage means along the sides of the sector pistons is advantageous especially in that the pressure of fluid in the apparatus is prevented from being communicated to the bearings. When the passage is along the outer circumference of the sector pistons, the pressure of fluid in the passage is exerted on the sector pistons and is transmitted to the bearings in which the sleeve element rotates. By having the passages at the side, the pressure exerted on the sector pistons

is reduced with resulting increase in efficiency of operation and long life of the parts. Moreover, the area of metal to metal contact between the rotating sector pistons and the cylinder block is increased so that wearing of the parts is reduced.

A further modification of this invention is shown in Figs. 13 and 14. In this modification of my invention, a fixed cylinder block 92 is employed having ports 93 and 93'. Within the casing, the sector pistons 94 are adapted to rotate, being held in position by the sleeve 95. The sleeve 95 is rotatably mounted by means of bearings 96 interposed between the sleeve and side wall members 97 of the pump chamber while side wall members as well as cylinder block 92 are extended to rotationally receive shaft 108. The structure of the sleeve may correspond to the structure of the sleeve shown in Fig. 4. The cylinder block 92 and side wall members 97 are assembled between castings 98 as by means of suitable bolts 99. The yoke 100 has fingers 101 with bearings 102 attached thereto and is affixed to shaft 103 by a suitable key. In this modification of the invention, the shaft is moved while the cylinder block 92 remains stationary so as to adjust the eccentricity between the axis of the cylinder block and the axis of the drive shaft. To accomplish this purpose, the drive shaft 103 is mounted in the ends of arms 104 having bearings 105 in which the drive shaft 103 rotates. The shaft 103 carries fixed on the end thereof a gear 106 which meshes with a gear 107 fixed to power shaft 115 which is concentric with shaft 108. The power shaft 115 is connected to any suitable source of power (not shown) and is mounted in suitable bearings (not shown).

The arms 104 can be moved so as to change the axis of shaft 103 with reference to the axis of cylinder block 92 by means of a lever 109 attached to arms 104 which, in turn are fixed on rotatable shaft 108, for example. At the upper end of the lever 109 there is a portion of worm gear 110 adapted to be actuated by worm wheel 111 which is operable by hand wheel 112. The worm wheel may be mounted in member 116 which may be fixed to or form a part of one of castings 98, for example, and may be provided with a cover plate 117. It is apparent that by rotating the wheel 112, the arms 104 can be rocked about their pivots so as to adjust the degree of eccentricity between the axis of shaft 103 and the axis of the cylinder block.

The operation of the modification of the apparatus shown in Figs. 13 and 14 is similar to the operation of the modifications above described. As in the modifications previously described, passage 113 communicating with port 93 and passage 113' communicating with port 93' and stop portions at 114 and 114' at the end of these passages divide any fluid in the apparatus into two independent portions between which there is a pressure differential during operation of the device as a compressor or as a motor.

While the units consisting of cylinder block, side wall members for the pump chamber and sleeve afford a substantially fluid-tight construction, there may be certain minor leakage between such parts so that a small amount of liquid will in time collect within the casing of the apparatus. Any such liquid can be readily drawn off by means of draw-off lines 118, shown in Fig. 2. The draw-off lines may, for example, return the liquid to the supply tank or may merely go to a suitable waste outlet.

It is to be understood that the structures above

described are specific embodiments of this invention which are merely illustrations of this invention and that structures embodying this invention may take many different forms. Thus while three or four sector pistons are shown, it is apparent that any other number of a plurality of sector pistons may be employed. Likewise, the dimensions of the apparatus may be varied. In this connection, the capacity of an installation can be readily changed merely by employing sector pistons (and cooperating cylinder block and sleeve) of different widths, as well as by increasing or diminishing the proportions of all of the parts of the apparatus. It is also to be understood that the various parts herein described can be made in single units or as a plurality of assembled, separate members. The cylinder block may, for example, be made of a plurality of parts. The cylinder block may also include other parts, such, for example, as the side wall members. Thus, the cylinder block may include not only that portion of the apparatus which contacts with the circumference of the sector pistons but also those parts of the apparatus which contact with the sides of the pistons, and when reference is made to a cylinder block having inlet and outlet ports, such ports may be in those parts of the apparatus contacting with the circumference of the sector pistons or those parts of the apparatus contacting with the sides of the sector pistons whether or not the cylinder block is made in one or more parts.

I claim:

1. Apparatus of the character described which comprises a non-rotatable cylinder block having an inlet port and an outlet port therein and having first and second arcuate passages in integral relation therewith communicating with said inlet and outlet ports, a plurality of sector pistons rotatably mounted within said cylinder block and having interiorly opening recesses therein, side wall members which are rigidly secured parts of said cylinder block and which are adapted to have surfaces thereof maintained in sliding contact with both sides of said sector pistons, a rotatable shaft passing through said cylinder block and mounted on both sides of said cylinder block in bearings disposed on both sides of said cylinder block adapted to permit rotation of said shaft therein while said shaft is maintained thereby eccentrically with respect to the axis of said cylinder block, a yoke fixed to said shaft having fingers extending outwardly and telescopically into said recesses of said sector pistons, fluid confining means adapted to contain a first portion of fluid in spaces between said sector pistons and in said first passage means communicating with said inlet port and to confine a second portion of fluid independently of said first portion in other spaces between said sector pistons and in said second passage means communicating with said outlet port, and means for securing relative movement between said shaft and cylinder block in a straight line.

2. Apparatus of the character described which comprises a non-rotating cylinder block having an inlet port and an outlet port therein, a plurality of sector pistons rotatably mounted within said cylinder block about an axis concentric with the axis of said cylinder block and having interiorly opening recesses therein, a rotatable shaft passing through said cylinder block and rotatably mounted in stationary bearings disposed on both sides of said cylinder block adapted to permit rotation of said shaft therein while said shaft

is maintained thereby eccentrically with respect to the axis of said cylinder block, a yoke fixed to said shaft having fingers extending outwardly and telescopically into said recesses in said sector pistons, side wall members which are rigidly secured parts of said cylinder block and which are on either side of said sector pistons in sliding contact therewith, first annular passage means comprised in said cylinder block communicating between spaces between said sector pistons and said inlet port, second annular passage means comprised in said cylinder block and independent of said first annular passage means communicating between other spaces between said sector pistons and said outlet port, and means for moving said cylinder block relative to said shaft to adjust the degree of eccentricity between the axes of said cylinder block and said shaft.

3. Apparatus of the character described which comprises a casing having openings therein, a cylinder block within said casing having an inlet port and an outlet port therein and including side wall members rigid therewith, a plurality of sector pistons rotatably mounted within said cylinder block about an axis substantially concentric with the axis of said cylinder block, a rotatable shaft mounted in fixed relation with respect to said casing by bearings on both sides of said cylinder block and having its axis substantially parallel to the axis of said cylinder block, means for moving said cylinder block relative to said shaft and to said casing to adjust the degree of eccentricity between the axis of said shaft and the axis of said cylinder block, means responsive to rotation of said shaft adapted to rotate said sector pistons at successively varying speeds when the axis of said shaft is maintained in eccentric relation to the axis of said cylinder block, fluid confining means adapted to confine a first portion of fluid in spaces between said sector pistons and in annular passage means comprised in said cylinder block communicating with said inlet port and to confine a second portion of fluid independently of said first portion in other spaces between said sector pistons and in annular passage means comprised in said cylinder block communicating with said outlet port, and connection means between said cylinder block and said casing including conduit means adapted to afford substantially fluid-tight communication between said inlet port in said cylinder block and one of the openings in said casing and between said outlet port in said cylinder block and another opening in said casing when said cylinder block is in a plurality of different positions relative to said shaft and to said casing, said connection means including one member integral with said cylinder block and another member integral with said casing, which members are adapted to slide relatively to each other when said cylinder block is moved relatively to said shaft and to said casing responsive to said means for moving said cylinder block relative to said shaft and to said casing.

4. Apparatus of the character described which comprises a casing having an inlet opening and an outlet opening therein, a cylinder block having an inlet port and an outlet port therein adapted to communicate respectively with said inlet and outlet openings in said casing with substantially fluid-tight sealing means adjacent the point of communication between said ports and said openings, said cylinder block being slidable laterally in said casing with respect to one of said openings, a plurality of sector pistons rotatably mounted within said cylinder block, a rotatable

shaft in fixed relation with respect to said casing and having its axis substantially parallel to the axis of said cylinder block, a sleeve rotatably mounted with respect to said cylinder block and with respect to said sector pistons by means of bearings integral with said cylinder block, said sleeve having openings therein and being adapted to maintain said sector pistons between said sleeve and said cylinder block and said bearings being adapted to maintain said sleeve and said cylinder block disposed about a common axis, a yoke fixed to said shaft having fingers passing outwardly through said openings in said sleeve and telescopically into recesses in said sector pistons, and means for moving said cylinder block laterally with respect to one of said openings in said casing to adjust the degree of eccentricity between the axis of said shaft and the axis of said cylinder block.

5. Apparatus of the character described which comprises a casing having an inlet opening and an outlet opening therein, a cylinder block having an inlet port and an outlet port therein, said cylinder block being slidably mounted in said casing, a plurality of sector pistons rotatably mounted within said cylinder block, a rotatable shaft in fixed relation to said casing and having its axis substantially parallel to the axis of said cylinder block, a sleeve rotatably mounted with respect to said cylinder block and with respect to said sector pistons by means of bearings integral with said cylinder block, said sleeve having openings therein and being adapted to maintain said sector pistons between said sleeve and said cylinder block and said bearings being adapted to maintain said sleeve and said cylinder block disposed about a common axis, a yoke fixed to said shaft having fingers passing outwardly through said openings in said sleeve and telescopically into recesses in said sector pistons, means for moving said cylinder block with respect to said casing and said shaft in a direction which varies the separation of one of said ports from one of said openings, and longitudinally slidable sealing means between said port and said opening adapted to afford a substantial fluid-tight seal between said port and said opening.

6. Apparatus of the character described which comprises a fixed cylinder block, a plurality of sector pistons rotatably mounted within said cylinder block, a rotatable shaft passing through said cylinder block and rotatably mounted in bearings disposed on both sides of said cylinder block adapted to permit rotation of said shaft therein while said shaft is maintained thereby eccentrically with respect to the axis of said cylinder block, a sleeve in slidable relation with respect to said sector pistons and adapted to maintain said sector pistons between said sleeve and said cylinder block, which sleeve is rotatably mounted in bearings interposed between said cylinder block and said sleeve adjacent both ends of said sleeve and adapted to maintain the said sleeve and said cylinder block disposed about a common axis, means responsive to rotation of said shaft for moving said sector pistons at successively varying speeds, and means for moving said shaft relatively to said cylinder block so as to adjust the degree of eccentricity between the axis of said shaft and the axis of said cylinder block.

7. Apparatus of the character described which comprises a fixed cylinder block, a plurality of sector pistons rotatably mounted within said cylinder block having interiorly opening recesses therein, a sleeve rotatably mounted with respect

to said cylinder block and with respect to said sector pistons, said sleeve being adapted to maintain said sector pistons between said sleeve and said cylinder block and having openings therein adapted to register with said recesses in said sector pistons, a rotatable shaft having its axis substantially parallel to the axis of said cylinder block, a yoke fixed to said shaft having fingers extending outwardly through said openings in said sleeve and telescopically into said recesses in said sector pistons, arms carrying said rotatable shaft, a power shaft, gears interposed between said power shaft and said rotatable shaft and adapted to drive said rotatable shaft from said power shaft, and means for moving said arms while maintaining said gears in operative relation to each other so as to move said rotatable shaft with reference to said cylinder block and so as to adjust the degree of eccentricity of the axis of said rotatable shaft with respect to the axis of said cylinder block.

8. Apparatus of the character described which comprises a cylinder block having an inlet port and an outlet port therein, a plurality of sector pistons rotatably mounted in said cylinder block and having interiorly opening recesses therein, side wall members which are rigidly secured parts of said cylinder block in slidable relation to both sides of said sector pistons, a sleeve in slidable relation with respect to said sector pistons and adapted to maintain said sector pistons between said sleeve and said cylinder block, said sleeve having portions adapted to close the bottom of spaces between said sector pistons and having openings between said portions in substantial registration with said recesses in said sector pistons and being rotatably mounted with respect to both of said side wall members by virtue of bearings interposed between each of said side wall members and said sleeve and adapted to maintain said sleeve and said cylinder block disposed about a common axis, a rotatable shaft adapted to be maintained with its axis in substantially parallel eccentric relation with the axis of said cylinder block, a yoke fixed to said shaft having outwardly extending fingers passing through said openings in said sleeve and telescopically into said recesses, first passage means communicating between spaces between said sector pistons and said inlet port, and second passage means independent of said first passage means communicating between other spaces between said sector pistons and said outlet port.

9. Apparatus of the character described which comprises a cylinder block having an inlet port and an outlet port therein, a plurality of sector pistons rotatably mounted in said cylinder block and having interiorly opening recesses therein, side wall members which are rigidly secured parts of said cylinder block in slidable relation to both sides of said sector pistons, a sleeve in slidable relation with respect to said sector pistons and adapted to maintain said sector pistons between said sleeve and said cylinder block, said sleeve having portions adapted to close the bottom of spaces between said sector pistons and having openings between said portions in substantial registration with said recesses in said sector pistons and being rotatably mounted with respect to both of said side wall members by virtue of bearings interposed between each of said side wall members and said sleeve and adapted to maintain said sleeve and cylinder block disposed about a common axis, a rotatable shaft adapted to be main-

tained with its axis in substantially parallel eccentric relation with the axis of said cylinder block, a yoke fixed to said shaft having outwardly extending fingers passing through said openings in said sleeve and telescopically into said recesses, first passage means comprised in said cylinder block communicating between spaces between said sector pistons and said inlet port, second passage means comprised in said cylinder block independent of said first passage means communicating between other spaces between said sector pistons and said outlet port, and means for securing relative movement between said shaft and said cylinder block so as to adjust the degree of eccentricity between the axis of said shaft and the axis of said cylinder block.

10. Apparatus of the character described which comprises a cylinder block having an inlet port and an outlet port therein, a plurality of sector pistons rotatably mounted in said cylinder block having interiorly opening recesses therein, a casing having an inlet opening and an outlet opening therein, a shaft rotatably mounted in said casing and having its axis substantially parallel to the axis of said cylinder block, side wall members which are rigidly secured parts of said cylinder block and which are adapted to have surfaces thereof maintained in sliding contact with both sides of said sector pistons, a sleeve in slidable relation with respect to the inner surfaces of said sector pistons and adapted to maintain said sector pistons between said sleeve and said cylinder block, said sleeve having portions adapted to close the bottoms of spaces between said sector pistons and openings between said portions adapted to register with said recesses in said sector pistons, a yoke fixed to said shaft having fingers extending through said openings and into said recesses, said casing being adapted to maintain said shaft and said cylinder block so that the axis of said shaft is in eccentric relation with respect to the axis of said cylinder block, first arcuate passage means comprised in said cylinder block communicating between spaces between said sector pistons and said inlet port, second arcuate passage means comprised in said cylinder block communicating between other spaces between said sector pistons and said outlet port, means for moving said cylinder block so as to adjust the degree of eccentricity between said shaft and said cylinder block, and connection means affording substantially fluid-tight connections between said ports in said cylinder block and said openings in said casing when said cylinder

block is in a plurality of different positions relative to said casing.

11. Apparatus of the character described which comprises a cylinder block having an inlet port and an outlet port therein, a plurality of sector pistons rotatably mounted in said cylinder block having interiorly opening recesses therein, a casing having an inlet opening and an outlet opening, a shaft rotatably mounted in said casing and having its axis substantially parallel to the axis of said cylinder block, side wall members which are rigidly secured parts of said cylinder block and which are adapted to have surfaces thereof maintained in sliding contact with both sides of said sector pistons, a sleeve in slidable relation with respect to the inner surfaces of said sector pistons and adapted to maintain said sector pistons between said sleeve and said cylinder block, said sleeve having portions adapted to close the bottoms of spaces between said sector pistons and openings between said portions adapted to register with said recesses in said sector pistons and being rotatably mounted with respect to both of said side wall members by virtue of bearings interposed between said side wall members and said sleeve, and adapted to maintain said sleeve and said cylinder block disposed about a common axis, a yoke fixed to said shaft having fingers extending through said openings and into said recesses, said casing being adapted to maintain said shaft and said cylinder block so that the axis of said shaft is in eccentric relation with respect to the axis of said cylinder block and bearings being on both sides of said cylinder block interposed between said shaft and said casing, first passage means comprised in cylinder block communicating between spaces between said sector pistons and said inlet port, second passage means comprised in said cylinder block communicating between other spaces between said sector pistons and said outlet port, substantially fluid-tight connections between said ports in said cylinder block and said openings in said casing, means interposed between said casing and said cylinder block for moving said cylinder block relatively to said shaft and to said casing so as to adjust the eccentricity of the axis of said shaft with respect to the axis of said cylinder block and means for maintaining said substantially fluid tight connections between said ports in said cylinder block and said openings in said casing when said cylinder block is in a plurality of different positions relative to said casing.

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